**NAME: ……………………………….. ADM NO: ………….. CLASS: …**

**233/2**

**CHEMISTRY**

**PAPER 2**

**MARKING SCHEME**

**INSTRUCTIONS TO CANDIDATES:**

**Answer all the questions in the spaces provided.**

**Mathematical tables and electronic calculators may be used.**

**All working must be clearly shown where necessary.**

1. The grid below represents part of the periodic table. Study it and answer the questions that

 follow.

 (a) Identity the family name to which element F and G belong. (1 mk)

 **Alkaline earth metals**

 (b) Name the type of bond formed when a and F belong. (1 mk)

 **Ionic bond**

 (c) Write the formula of the oxide formed when D reacts with oxygen. (1 mk)

 **D2O3**

 (d) What type of oxide is formed in (c) above. (1 mk)

 **Amphoteric oxide**

 (e) Compare the atomic radii of F and D. Explain. (2 mks)

**- Has a smaller atomic radius than F because D has more protons hence stronger**

 **nuclear attraction compared to F.**

 (f) Element F burns in air to form two products. Write two equations of the two products

 formed. (3 mks)

 **2F(s) + O2(g) 2FO(s)**

 **3F(s) + N2(g)  F3N2(s)**

 (g) Stat e two uses of element K and its compounds. (2 mks)

 **- K cyanide is used in the extraction of gold**

 **- Mixture of K and potassium is used as nuclear coolant.**

2. (a) Name the following organic compounds.

 (i) CH3CH2CH(Br)CH3

 **2, 3 – dibromo – 2 - chloropentane**

O

 O

(ii) CH3-CH2CH2-CH2-C-OH

OH

 **Butanoic acid**

(iii) CH2CHCH2CH(Br)CH3

 **4 – bromopent-i-ene**

 (b) Study the flow chart below and answer the questions that follow.

 Name:-

 (i) The process that occur in steps marked I, II and IV. (1 mk)

 **I – cracking**

 **II- Hydrogenation**

 **IV – Oxidation**

 (ii) The reagent and conditions in step II. (1½ mks)

 **Reagent – hydrogen**

 **Conditions – temp 150 – 250oC, nickel catalyst**

 (iii) Draw t he structural formula of substance X, give the name of the substance. (2 mks)

 Cl Cl

 │ │

 Cl ─ C ─ C ─ Cl

 │ │

 Cl Cl

 (c) The diagram below shows a structure of a cleansing agent.

**OSO3-Na+**

 R

 (i) Name the cleansing agent above. (1 mk)

 **Sodium alkylbenzene sulphonate**

 (ii) State the type of cleansing agent above. (1 mk)

 **Soapless detergent**

 (iii) Name the material added to the cleansing agent in order to improve its cleansing

 property.

 **Tetraoxophosphate materials**

3. (a) 50cm3 of 1M copper (II) Sulphate solution was placed in a 100cm3 plastic beaker. The

 temperature of the solution was measured. Excess metal A powder was added to the

 solution, the mixture stirred and the maximum temperature was repeated using powder of

 metal B and C. The results obtained are given in the table below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **A** | **B** | **C** |
| Maximum temperature oC |  | 2.63 | 31.7 | 22.0 |
| Initial temperature (oC) |  | 22.0 | 22.0 | 22.0 |

(i) Arrange the metal A, B, C and Copper in order of reactivity starting with the least

 reactive. Give reasons for the order. (3 marks)

 **C, Copper, A, B.**

 **B is the most reactive because it has highest** $∆$**T.**

 **C is the least reactive because it cannot displace ions of copper from solution.**

 **A is more reactive than Copper because it displaces Cu2+ from solutions.**

 (ii) Other than temperature change, state one other observation that was made when the

 most reactive metal was added to the copper (II) Sulphate solution. (1 mk)

 **- Blue colour of the solution fades /disappeared**

 **- Black deposit is formed.**

 (b) The Standard enthalpy change of formation of methanol is -239Kjmol-1

 (i) Write the thermal chemical equation for the standard enthalpy change of formation of

 methanol. (1 mk)

**C(s) + 2H2(g) + ½ O2(g) H3OH(g)** $∆H= -239Kjg/mol$

 (ii) Use the following data to calculate the enthalpy change for the manufacture of methanol

 from carbon (II) oxide and hydrogen. (3 mks)

 CO(g) + ½ O2(g) CO2; $∆$Hɵ  = -283Kj/mol

 H2(g) + ½ O2(g) H2O(l); = $∆$Hɵ = -286Kj/mol

 CH3OH + $^{3}/\_{2}$ CO2(g) + 2H2O; $∆$Hɵ = -715Kj/mol

 **C + 2H2 + ½ O2 CH3OH**

$∆$**H= -283Kj/mol** $∆H= -286Kj/mol$$∆H=-715Kj/mol$

 **O2 O2 O2**

 **CO2 + H2O**

$∆H$**σCH3OH =** $∆$**HcC +** $∆$**HcH2 -** $∆$**HcCH3OH**

 **= -283 + 2(-286) – (-715)**

 **= -283 – 576 + 715**

 **= -859 + 715**

$∆H$**f CH3OH = - 144Kj/mol**

 (c) Study the information given in the table below and answer the questions that follow.

|  |  |
| --- | --- |
| Bond | Bond energy (Kjmol-1 |
| C – HCl – ClC – ClH - Cl | 414244326431 |

 Calculate the enthalpy change for the reaction. (3 mks)

 **CH4(g) + Cl2(g)  CH3Cl(g) + HCl(g)**

 **H H**

 **│ │**

 **H ─C─H + Cl─H H─C─Cl + H─Cl**

 **│ │**

 **H H**

 **Bond breaking energy – Bond formation energy**

 **BBE - BFE**

 **4(414) + 244 = 3 (414 + 326 + 431**

 **(1900 – 1999) = -99Kj**

 **= -99Kj**

4. Carbon IV oxide is produced when solid X is heated strongly. It can also be prepared by adding

 dilute hydrochloric acid to solid X. The reaction between X and dilute Sulphuric acid, however

 gradually slows down and stops.

 (a) (i) Name solid X. (1 mk)

 **Calcium carbonate**

 (ii) Write an ionic equation for the reaction of X and acid. (1 mk)

 **CO32-(s) + 2H+(aq)  CO2(g) + H2O(l)**

 (b) A gas jar full of Carbon (IV) oxide was inverted over burning candle.

 (i) State the observations made. (1 mk)

 **Candle is immediately extinguished**

 (ii) What two properties of carbon (IV) oxide does this observation illustrate. (2 mks)

 **- It does not support combustion and it is denser than air since it is poured**

**downwards from gas jar.**

 (iii) Name a practical everyday use of this property of carbon (IV) oxide. (1 mk)

 **As a fire extinguisher**

 (c) The flow diagram below shows some reactions of calcium compounds.

 (i) Name compound F and G. (2 mks)

 **F = Calcium carbonate**

 **G = Calcium hydroxide**

 (ii) Write equations for reactions in step A, B and C. (3 mks)

 **Step A: CaCO3(s) + H2O(l) + CO2(g) Ca(HCO3)2(aq)**

Boil

 **Step B: Ca(HCO3)2(aq) CaCO3(s) + CO2(g) + H2O(l)**

 **Step C: Ca(OH)2(g) CaCO3(s) + H2O**

5. A piece of sodium metal which had been exposed to air, was found to be covered with a white

 powder. The piece was dropped into 50g of ethanol and 2400cm3 of hydrogen gas measured at

 room temperature and pressure was obtained. The unused ethanol was distilled off and a white

 solid remained (Na = 23, molar gas volume at room temperature and pressure = 24dm3)

 (i) Name the other substance formed other than hydrogen. (1 mk)

 **Sodium ethoxide**

 (ii) Calculate the mass of sodium that dissolved in ethanol. (2 mks)

 **2C2H5OH(l) + 2Na(s) 2C2H5ONa(l) + H2(g)**

 **2 moles Na gives 1 mole H2 at r.t.p.**

 **46g Na gives 24.000cm3**

 **2400cm3**

 **2400cm3 x 46g**

 **24000cm3 = 4.6g of sodium**

 (iii) What mass of ethanol was distilled of assuming there was no loss during the process?

 (2 mks)

 **2 moles of C2H5OH 1 mole of H2 gas**

 **(2 x 46)g C2H5OH gives 24000cm3**

 **X 2400cm3**

 **2 x 46 x 2400**

 **2400 = 9.2g**

 **Mass of distilled = (50g – 9.2g) = 40.8g**

 (iv) The ethanol was distilled off at 80oC, while the white solid remained unaffected at this

 temperature. What is the difference in structure of ethanol and the white solid. (2 mks)

**Ethanol is molecular structure with hydrogen bonds between molecules while white solid must be giant ionic structure with strong ionic bonds.**

 (b) Name another liquid which produces;

 (i) Hydrogen with sodium metal. (1 mk)

 **Water**

 (ii) What difference would you observe if identical pieces of sodium were dropped

 separately into small beakers containing ethanol and this other liquid? (2 mks)

|  |  |
| --- | --- |
| **In ethanol** | **In water** |
| **Sinks, gas bubbles are formed** | **Floats on surfaces, reacts vigorously and darts on surface producing a hissing sound.** |

 (c) (i) Name the white powder coating the original piece of sodium, explain how it was formed.

 (3 mks)

**Sodium in air forms sodium oxide, which in presence of moisture forms sodium hydroxide, which reacts with carbon (iv) oxide in air to form sodium carbonate.**

 (ii) Describe one test by which you could identify white powder which originally covered

 sodium. (2 mks)

**Add dilute HCl acid. Effervescence occurs and colourless gas is given off which forms a white precipitate in lime water.**

6. The scheme below shows various reactions starting with hydrogen and nitrogen. Study it

 carefully and answer the questions that follow.

 (i) Give one condition other than the of a catalyst that would favour the reaction in step I. (1 mk)

 **High pressure**

 (ii) Name the catalysts used in step I and II. (2 mks)

 **Step I - finely divided iron**

 **Step II – Vanadium V oxide/platinum**

 (iii) Name substances P, Q, X and Y . (2 mks)

 **P – ammonium sulplhate**

 **Q – Copper metal**

 **X – Oxygen**

 **Y – nitrogen gas**

 (iv) Write equations for the reactions that takes kplace in step II. (3 mks)

catalyst

 **4NH3(g) + 5O2(g)  4NO(g) + 6H2O(l)**

 **2NO(s) + O2(g) 2NO2**

 **4NO2(g) + 2H2O(g) + O2(g)  HNO3(aq)**

 (v) Name the oxidizing agent for the reaction that takes place in step IV. (1 mk)

 **Nitric acid**

 (vi) Why is a concentrated nitric acid transported on aluminium container and not copper? (1 mk)

**Concentrated nitric acid with copper oxidizes it to Copper(II) nitrate, while aluminium forms layer of aluminium oxide which is a passive and stops any further action by the acid.**

 7. Use standard electric potentials for elements A, B, C, D and F given below to answer the

 questions that follow.

 Eɵ (volts)

 A2+(aq) + 2e- A(s) -2.90

 B2+(aq) + 2e- B(s) -2.38

 C+(aq) + 2e- ½ C(g) -0.00

 D2+(aq)  + 2e- D(s) +0.34

 ½ F2(g) + e- F-(aq) +2.87

 (i) Which element is likely to be hydrogen? Give a reason for your answer. (2 mks)

 **C+/C2 = hydrogen is used as the reference electrode**

 **Eɵ value is 0.00/standard electrode potential**

 (ii) What is the Eɵ value of the strongest reducing. (1 mk)

 **Eɵ = -2.90V**

 (iii) In the space provided, draw a labeled diagram of the electrochemical cell that would be

 obtained when half-cells of elements B and D are combined. (3 mks)

 

 (iv) Calculate the Eɵ value of the strongest reducing agent. (2 mks)

 **2.38 + 0.34 = 2.72**

 **0.34 –(-2.38) = +2.72**

 **(0.34 + 2.38) = +2.72V**

 (b) During the electrolysis of aqueous copper II Sulphate using copper electrodes, al current of

 0.2 amperes was passed through the cell for 5 hours.

 (i) Write an ionic equation for the reaction that took place at the anode. (1 mk)

 **Cu(s)  Cu2+(aq) + 2e-**

 **or**

 **Cu(s) Cu2+(aq)**

 (ii) Determine the change in mass of the anode which occurred as a result of the electrolysis

 process. (C.u = 63.5, 1 Faraday = 96,500 coulombs) (2 mks)

 **C = AI**

 **(0.2 x 5 x 60 x 60)**

 **0.2 x 5 x 60 x 60 x 63.5**

 **2 x 96500**

 **63 .5g Cu requires 2 x 96500**

 **3600 C produces 63. 5 x 3600**

 **2 x 96500**

 **= 1.18gm**